

ANNUAL REPORT 2021-2022



INSTITUTE OF FUEL RESEARCH AND DEVELOPMENT (IFRD)
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH (BCSIR)

IFRD ANNUAL REPORT 2021-2022



Institute of Fuel Research and Development (IFRD)
Bangladesh Council of Scientific and Industrial Research (BCSIR)

Dr. Quadrat-i-Khuda Road, Dhanmondi, Dhaka-1205

e-mail: dir-ifrd@bcsir.gov.bd, Phone: 02-58615614, Website: <http://ifrd.bcsir.gov.bd>



Message from the Chairman of BCSIR

I am pleased to acknowledge that Institute of Fuel Research and Development (IFRD) of Bangladesh Council of Scientific and Industrial Research (BCSIR) will issue its annual report for the fiscal year 2021-2022. I do admire their competence and enthusiasm.

Research and development on conventional and renewable fuels is one of the ways by which IFRD contributes significantly to R&D activities and upholds the perfection of its goal and vision while addressing the current energy crisis, reducing carbon emission, and climate change challenges. In addition, IFRD provides analytical services to a wide range of stakeholders across the nation, technology transfer services, the dissemination of appropriate technology, the solution to industrial problems, human resource development, public awareness, consultancy services and technical backup services, and supervision of postgraduate and PhD students. The IFRD, traditionally been a leader in the field of fuel and energy research in Bangladesh, is working on Solar cell fabrication research and producing a number of commercially successful products such as the portable fiberglass biogas plant, improved cook stove (ICS), brake oil, etc. Moreover, in order to acquire official certification of technical proficiency in accordance with international norms, IFRD is working on the Laboratory Accreditation protocol.

The Fourth Industrial Revolution is now underway. Billions of people are connected via mobile devices, with previously unheard-of levels of computing power, storage, and knowledge accessibility, hence the possibilities are endless. Furthermore, new technologies like artificial intelligence (AI), robotics, 3-D printing, autonomous vehicles, nanotechnology, internet of things (IoT), biotechnology, materials science, energy storage, and quantum computing will increase the number of options. From the very beginning, IFRD has demonstrated their abilities and uniqueness. To meet the global energy crisis, this institute plays a noteworthy role in the fuel and energy-based technology research. Alongside, different group of IFRD is working on IoT devices, industrial automations, surveillance drone technology, smart phone app for solar home design to harness converging technologies in order to create an inclusive, human-centered future.

I would like to recall the name of the Father of the Nation Bangabandhu Sheikh Mujibur Rahman, the greatest Bangali of all time, with humble respect for his supreme leadership to achieve the independence of Bangladesh in 1971. Bangladesh is now referred to as a "Role Model for Development" all over the world, because of our Honorable Prime Minister, the visionary leader Sheikh Hasina. I am utterly grateful to the Prime Minister for her outstanding contribution promoting science and technology.

I must extend my sincere gratitude to Honorable Minister Architect Yeafesh Osman, Ministry of Science and Technology, for his generous support and guidance. I would like to express my cordial thanks to Senior Secretary Mr. Ziaul Hasan ndc, Ministry of Science and Technology, for his continuous support.

The Director and all of the publication committee members deserve my heartiest congratulations for devoting their time and efforts to the preparation of this annual report. I wish good luck to IFRD on this joyous occasion as well.

Joy Bangla! Joy Bangabandhu!

May Bangladesh live long!

(Professor Dr. Md. Aftab Ali Shaikh)
Chairman
BCSIR

Message from the Director

It is a great honor to inform you that the annual report for 2021-2022 has been published by the Institute of Fuel Research and Development (IFRD) of the Bangladesh Council of Scientific and Industrial Research (BCSIR). Taking into account the IFRD's overall efforts and accomplishments, this annual report is a compilation of all of their activities throughout the fiscal year, including research and development, technology distribution, training, seminars, and workshops etc.

In order to address the global energy issue, IFRD primarily conducts R&D work on various fuels and alternative energy sources. For the first time in our nation, researchers are working on the manufacture of second and third generation solar cells in the IFRD's world-class Solar Energy Technology Laboratory. Additionally, IFRD disseminates suitable technology in Bangladesh's rural and urban areas to promote knowledge of biogas and improved cook stoves (ICS). I have the honor of overseeing this renowned BCSIR institution, which has a personnel and scientific team that is extremely talented and committed. This annual report is an acknowledgement of the valuable research accomplishments and hard work of the scientists, officers, technicians and our honorable stakeholders in supporting the institute to meetup its objectives, mission and vision.

I want to extend my sincere gratitude to the members of the annual report committee for their tireless efforts and prolific actions to timely publish this annual report. I owe a huge debt of gratitude to the scientists, technicians, and support staff for their diligent assistance throughout. In addition, I want to sincerely thank renowned Professor Dr. Md. Aftab Ali Shaikh, Chairman of the BCSIR, for all of his inspiration and support throughout the entire process.



(Dr. Shahin Aziz)
Director (Addl. Charge)
IFRD, BCSIR





Message from the Convenor

It is my utmost pleasure to report that, Institute of Fuel Research and Development (IFRD), Bangladesh Council of Scientific & Industrial Research (BCSIR), Dhaka is picking up acceleration with every successive year. This annual report (2021-2022) includes the progress of IFRD's R&D activities, training, seminar, workshop, etc. during the entire year. IFRD has demonstrated its ability to lead as a pioneering institute in the field of fuel and energy research since its beginning. This institute plays a significant role in R&D activities on conventional and non-conventional energy sources and the dissemination of appropriate technologies. Last year, IFRD has continued to advance its mission by carrying out R & D on renewable and conventional fuels to address the energy crisis of the present and the future, as well as to address the climate change problem by being engaged in research concerning renewable energy and carbon neutral fuels. This institute has a multidisciplinary group of researchers working on the development of renewable energy technology involving numerous scientific domains such as thin film solar cells, biofuels, etc. This institute takes part in and organizes seminars and workshops to raise public knowledge about appropriate, sustainable, and cleaner fuel technologies such as biogas, improved cooking stoves, and solar energy.

I consider myself fortunate and privileged to be a part of this prestigious institute of BCSIR, which is staffed by a devoted and highly skilled team of scientists, technicians, officers, and other personnel. I want to express my gratitude to all the members of the annual report preparation committee for their dedication and hard work. I would like to thank the Director of IFRD, BCSIR Dhaka for her kind cooperation and support. Finally, I would be honored to offer my heartfelt gratitude and special thanks to Professor Dr. Md. Aftab Ali Shaikh, Chairman, BCSIR, for his assistance and assurance in the Institute's R&D and other endeavors.

(Dr. Mohammad Shah Jamal)
Principal Scientific Officer
& Convenor
Publication committee
IFRD, BCSIR

Publication Committee



Dr. Mohammad Shah Jamal
Principal Scientific Officer
Convener



Md. Saidul Islam
Senior Scientific Officer
Member Secretary



Afrina Sharmin
Senior Scientific Officer
Member



Md. Azizul Hoque
Senior Scientific Officer
Member



Ayesha Siddika
Scientific Officer
Member

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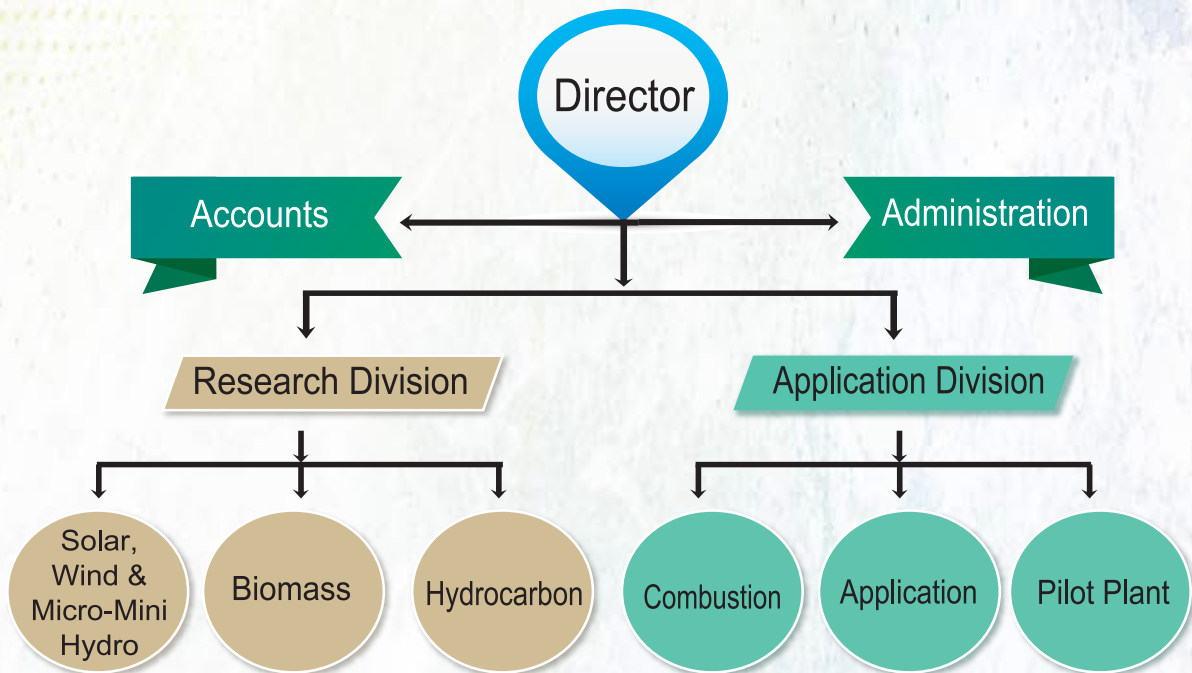
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Preface

The Institute of Fuel Research and Development (IFRD) is a renowned organization for its Research and Development (R&D) activities on conventional and non-conventional energy and dissemination of appropriate technology to the grassroots level. The organization plays a vital role on conservation of energy in industrial sectors. IFRD launched its journey as the Fuel Research Division of the East Regional Laboratories, Dhaka in 1955.

In 1967 it was renamed as Fuel & Petrochemical Science and Technology Division of the East Regional Laboratories. After the independence, it was again renamed as Fuel Division of BCSIR Laboratories, Dhaka. In 1980, the institute of Fuel Research and Development was established as a separate institute of BCSIR with two Divisions named Research division and Application division.

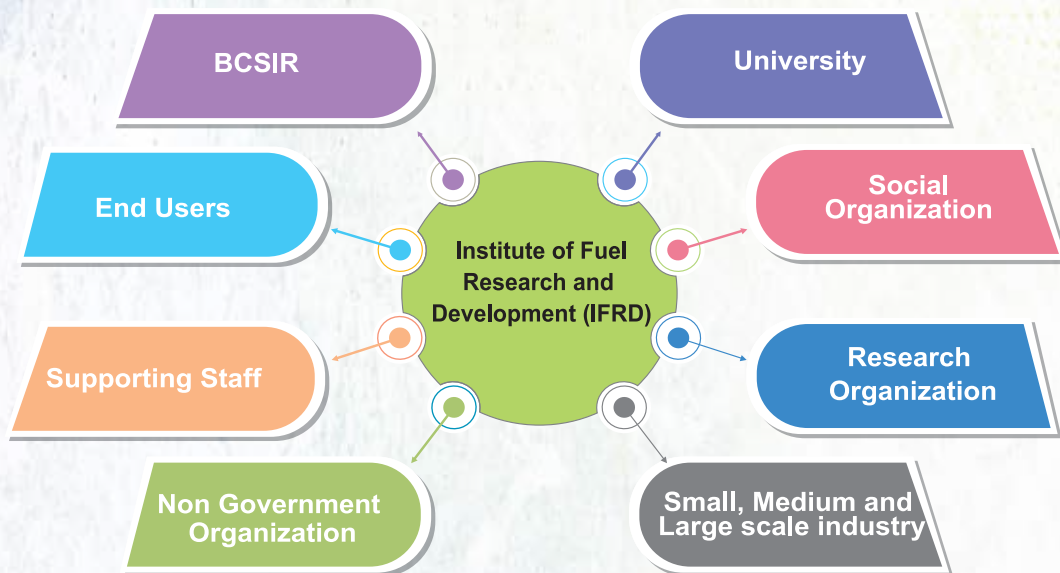
Organizational Diagram of IFRD



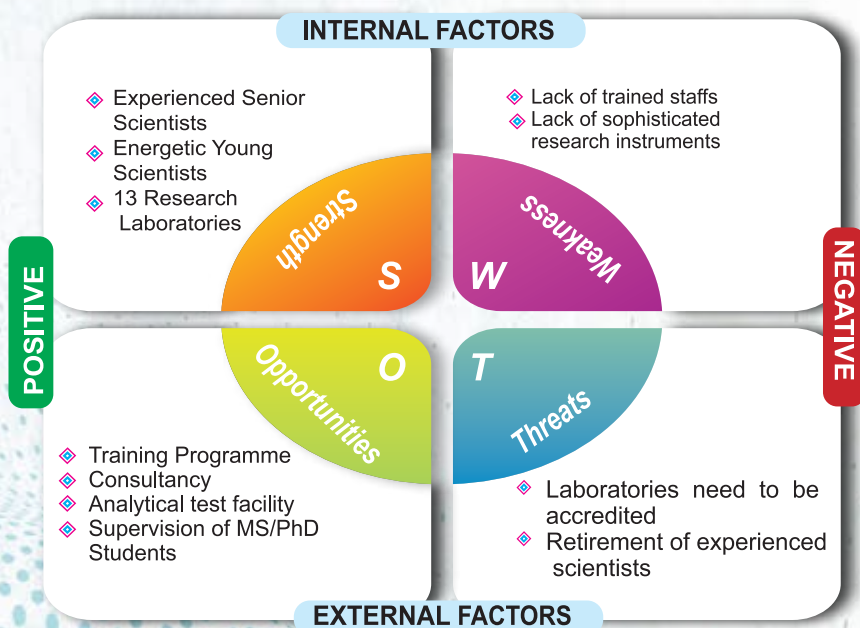
Management Strategy of IFRD



Stakeholders of IFRD



SWOT Analysis



Vision of IFRD

To be pioneer in research and development activities on conventional and non-conventional energy system

Mission of IFRD

- ✧ To conduct world-class research on energy technology and management for economic and environmental sustainability
- ✧ To innovate through research and development and disseminate sustainable products to the nation
- ✧ Creating linkages among international energy research institutions
- ✧ Developing cutting edge technologies for analytical service

Objectives of IFRD

- ✧ Utilizing the existing traditional and commercial fuels more efficiently by improving the efficiencies of different burning devices commonly used in the country
- ✧ Acquiring better technology for production of bioenergy by utilizing biomass and other organic wastes for the generation of electricity to improve the socio-economic condition of the rural people
- ✧ Developing appropriate technologies for the utilization of new and renewable sources of energy, e.g. solar, wind and hydro
- ✧ Studying the environmental pollution caused by the emission of smoke and other poisonous gases from automobile and industries
- ✧ Analysing different commercial products used as fuels and allied products supplied by different local industries and other producers

Activities of IFRD

- ✧ Conducting basic and applied R&D activities on solar energy, biogas, biomass, bio-fuel, wind energy and all other renewable and non-renewable energy resources
- ✧ Providing qualitative and quantitative analytical service of traditional fossil fuel as well as all sorts of energy resources and related products.
- ✧ Providing consultancy service to Government and Non-Government organizations
- ✧ Disseminating appropriate technologies to various level of entrepreneurs
- ✧ Supervising undergraduate, graduate and post graduate students

Citizen's Charter of IFRD

প্রতিশ্রুত সেবাসমূহ:

২.১) নাগরিক সেবা

ক্রমিক নং	সেবার নাম	সেবা প্রদানে সর্বোচ্চ সময়	প্রয়োজনীয় কাগজপত্র	প্রয়োজনীয় কাগজপত্র/ আবেদন ফরম প্রাপ্তিস্থান	সেবার মূল্য এবং পরিশোধ পদ্ধতি (যদি থাকে)	শাখার নামসহ দায়িত্বপ্রাপ্ত কর্মকর্তার পদবি, রুম নম্বর, জেলা/ উপজেলার কোড, অফিসিয়াল টেলিফোন ও ইমেইল	উর্ধ্বতন কর্মকর্তার পদবি, রুম নম্বর সহ অফিসিয়াল টেলিফোন ও ইমেইল
০১	পণ্যমান বিশ্লেষণ	সাধারণত ৭ (সাত) কর্ম দিবস, প্রযোজ্য ক্ষেত্রে ৭ (সাত) কর্ম দিবসের অধিক	• নির্ধারিত ফরমে আবেদনপত্র জমা (অনলাইনের মাধ্যমে) • বিশ্লেষণ ফি জমা রশিদ	এ্যানালাইটিক্যাল সার্ভিস সেল বিসিএসআইআর, ঢাকা ওয়েবসাইট: www.bcsir.gov.bd টেলিফোন: ০২-৯৬৭১১০৮	বিসিএসআইআর কর্তৃক নির্ধারিত বিশ্লেষণ ফি (ভ্যাটসহ), চেক/নগদ টাকা ব্যাংকে জমাদান	ড. মোহাম্মদ শাহ জামাল প্রিন্সিপাল সায়েন্সিফিক অফিসার আইএফআরডি, রুম নং: ১১৫ ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: msjdubd@gmail.com	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা টেলিফোন: ০২-৫৮৬১৫৬১৪ ই-মেইল: dir-ifrd@bcsir.gov.bd
০২	প্রযুক্তি হস্তান্তর	বিসিএসআইআর -এর সদস্য (উন্নয়ন)-এর কার্যালয় কর্তৃক নির্ধারিত	বিসিএসআইআর এর উন্নয়ন বিভাগ কর্তৃক নির্ধারিত ফরম	উন্নয়ন বিভাগ, বিসিএসআইআর, ঢাকা	প্রযুক্তি অনুযায়ী বিধি মোতাবেক মূল্য নির্ধারিত হয়	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd	সদস্য (উন্নয়ন), বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১০৭১৪ ই-মেইল: zakerh364@gmail.com
০৩	প্রযুক্তি সম্প্রসারণ কার্যক্রম	বার্ষিক উন্নয়ন প্রকল্পে নির্ধারিত সময়/ প্রজেক্টের ধরনের উপর নির্ভরশীল	আবেদনপত্র	পরিচালক দপ্তর, আইএফআরডি বিসিএসআইআর, ঢাকা	সরকারি আদেশ ও বিসিএসআইআর-এর আদেশ মোতাবেক	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd
০৪	যুক্তিযুক্তিক সেবা	সেবার ধরণ ও প্রকৃতি অনুযায়ী নির্ধারিত	আবেদনপত্র	পরিচালকের দপ্তর, আইএফআরডি বিসিএসআইআর, ঢাকা	সেবার ধরণ ও প্রকৃতি অনুযায়ী বিসিএসআইআর কর্তৃক নির্ধারিত	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd
০৫	মানব সম্পদ উন্নয়ন	সংশ্লিষ্ট প্রতিষ্ঠানের চাহিদা ও প্রশিক্ষণের প্রকৃতি অনুযায়ী নির্ধারিত	আবেদনপত্র	পরিচালকের দপ্তর, আইএফআরডি বিসিএসআইআর, ঢাকা	সেবার ধরণ ও প্রকৃতি অনুযায়ী বিসিএসআইআর কর্তৃক নির্ধারিত	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd
০৬	বিভিন্ন শিল্প- কারখানার সমস্যা সমাধান	সমস্যার ধরণ ও প্রকৃতি অনুযায়ী নির্ধারিত	আবেদনপত্র	পরিচালকের দপ্তর, আইএফআরডি বিসিএসআইআর, ঢাকা	সেবার ধরণ ও প্রকৃতি অনুযায়ী বিসিএসআইআর কর্তৃক নির্ধারিত	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd

২.২) প্রাতিষ্ঠানিক সেবা

ক্রমিক নং	সেবার নাম	সেবা প্রদানে সর্বোচ্চ সময়	প্রয়োজনীয় কাগজপত্র	প্রয়োজনীয় কাগজপত্র/ আবেদন ফরম প্রাপ্তিস্থান	সেবার মূল্য এবং পরিশোধ পদ্ধতি (যদি থাকে)	শাখার নামসহ দায়িত্বপ্রাপ্ত কর্মকর্তার পদবি, রুম নম্বর, জেলা/ উপজেলার কোড, অফিসিয়াল টেলিফোন ও ইমেইল	উর্ধ্বতন কর্মকর্তার পদবি, রুম নম্বর সহ অফিসিয়াল টেলিফোন ও ইমেইল
০১	যন্ত্রপাতির উপর প্রশিক্ষণ প্রদান	প্রশিক্ষণের ধরণ ও প্রকৃতি অনুযায়ী নির্ধারিত	বিসিএসআইআর কর্তৃক অনুমোদিত প্রশিক্ষণ সংক্রান্ত অনুমতিপত্র	ক) পরিচালকের কার্যালয়, আইএফআরডি খ) পরিকল্পনা ও উন্নয়ন বিভাগ, বিসিএসআইআর, ঢাকা গ) CARF, বিসিএসআইআর, ঢাকা	প্রশিক্ষণের প্রকৃতি অনুযায়ী বিসিএসআইআর কর্তৃক নির্ধারিত	পরিচালক কার্যালয় আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা টেলিফোন: ০২-৫৮৬১৫৬১৪ ই-মেইল: dir-ifrd@bcsir.gov.bd
০২	বিভিন্ন বিশ্ববিদ্যালয়ের ছাত্র-ছাত্রীদের গবেষণায় সহায়তা করা	প্রয়োজনানুসারে	পরিষদ কর্তৃক অনুমোদনপত্র গবেষণা সমন্বয়কারী দপ্তর, বিসিএসআইআর, ঢাকা	গবেষণা সমন্বয়কারীর অফিস এবং বিসিএসআইআর এর ওয়েবসাইট	বিনামূল্যে	সংশ্লিষ্ট বিজ্ঞানী এবং পরিচালক কার্যালয়, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা টেলিফোন: ০২-৫৮৬১৫৬১৪ ই-মেইল: dir-ifrd@bcsir.gov.bd
০৩	রিসার্চ ফেলোদের গবেষণা কার্যক্রম তত্ত্বাবধান	বিসিএসআইআর কর্তৃক নির্ধারিত মোয়াদে	বিসিএসআইআর কর্তৃক নির্ধারিত ফরম	পরিষদ সচিবালয় এবং বিসিএসআইআর এর ওয়েবসাইট	বিনামূল্যে	সংশ্লিষ্ট বিজ্ঞানী এবং পরিচালক কার্যালয়, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা টেলিফোন: ০২-৫৮৬১৫৬১৪ ই-মেইল: dir-ifrd@bcsir.gov.bd
০৪	বার্ষিক প্রতিবেদন	প্রকাশনার পর ৭ (সাত) কর্ম দিবস	যথাযথ কর্তৃপক্ষ কর্তৃক অনুমোদনপত্র	পরিচালক দপ্তর, আইএফআরডি, বিসিএসআইআর, ঢাকা	বিনামূল্যে	পরিচালকের কার্যালয়, আইএফআরডি, বিসিএসআইআর, ঢাকা ইমেইল: dir-ifrd@bcsir.gov.bd	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd

২.৩) অভ্যন্তরীণ সেবা

ক্রমিক নং	সেবার নাম	সেবা প্রদানে সর্বোচ্চ সময়	প্রয়োজনীয় কাগজপত্র	প্রয়োজনীয় কাগজপত্র/ আবেদন ফরম প্রাপ্তিস্থান	সেবার মূল্য এবং পরিশোধ পদ্ধতি (যদি থাকে)	শাখার নামসহ দায়িত্বপ্রাপ্ত কর্মকর্তার পদবি, রুম নম্বর, জেলা/ উপজেলার কোড, অফিসিয়াল টেলিফোন ও ইমেইল	উর্ধ্বতন কর্মকর্তার পদবি, রুম নম্বর সহ অফিসিয়াল টেলিফোন ও ইমেইল
০১	গবেষণা বিষয়ক অভ্যন্তরীণ সেমিনার কর্মসূচী	পত্র প্রাপ্তির পর ৭ (সাত) কর্ম দিবস	নথিপত্র	প্রশাসন ও হিসাব বিভাগ, আইএফআরডি, বিসিএসআইআর, ঢাকা	বিনামূল্যে	জনাব ইব্রাহিম খলিল, প্রশাসনিক কর্মকর্তা আইএফআরডি, ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ই-মেইল: dir-ifrd@bcsir.gov.bd
০২	সুস্বাদ্য, নৈতিকতা সম্পর্কিত প্রশিক্ষণ কার্যক্রম	আইএফআরডি কর্তৃক নির্ধারিত মোয়াদে	বিসিএসআইআর কর্তৃক প্রদত্ত অফিস আদেশ ও নির্দেশনা	পরিচালকের কার্যালয়, আইএফআরডি, বিসিএসআইআর, ঢাকা	বিনামূল্যে	জনাব ইব্রাহিম খলিল, প্রশাসনিক কর্মকর্তা আইএফআরডি, ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ই-মেইল: dir-ifrd@bcsir.gov.bd
০৩	আইএফআরডি এর কর্মচারীদের কল্যাণ তহবিল থেকে অনুদান প্রদান	আইএফআরডি কর্তৃক নির্ধারিত মোয়াদে	আবেদনপত্র	পরিচালকের কার্যালয়, আইএফআরডি, বিসিএসআইআর, ঢাকা	বিনামূল্যে	জনাব ইব্রাহিম খলিল, প্রশাসনিক কর্মকর্তা আইএফআরডি, ফোন: ০২-৫৮৬১৫৬১৪ ইমেইল: dir-ifrd@bcsir.gov.bd	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ই-মেইল: dir-ifrd@bcsir.gov.bd
০৪	গবেষণা নমুনার বিশ্লেষণ	সর্বোচ্চ ০৭ কর্মদিবস	আবেদনপত্র	পরিচালকের কার্যালয় আইএফআরডি, বিসিএসআইআর, ঢাকা	বিনামূল্যে	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ই-মেইল: dir-ifrd@bcsir.gov.bd	পরিচালক, আইএফআরডি, বিসিএসআইআর, ঢাকা ফোন: ০২-৫৮৬১৫৬১৪ ই-মেইল: dir-ifrd@bcsir.gov.bd

Remarkable Achievements of IFRD

ADP & Others Projects	◆ Biogas Pilot Plant Project (1995-2000, 2000-2004) ◆ Fuel Saving Project (1988-1991, 1994-1997) ◆ Feasibility study on R&D of Renewable Energy Technology (Solar, Wind and Micro-Mini Hydro) ◆ Bangladesh Climate Change Trust Fund Project (2011-2013) ◆ Bangladesh Climate Change Trust Fund Project (2014-2016) ◆ Development of Technology for the production of Low-Cost Solar Power (2012-2016)
Important Products	◆ Different types of Improved Cook Stove ◆ Fixed Dome Biogas Plant ◆ Fiber Glass Portable Biogas Plant ◆ Brake Oil ◆ Radiator Coolant ◆ Machine Oil ◆ Solar Oven, Solar Dryer, Solar Hot Water System ◆ Solar Farm hat, Solar Charging Backpack ◆ Biofuel ◆ Smart Light Control System ◆ G-Lamp ◆ Multijunction Solar Cell Simulator ◆ Automatic Sun Tracker ◆ Smart Furnace Controller
Paper	~ 280
Process	59
Patent	46
Awareness creation	Organized Seminar and Display of appropriate technology (Biogas and ICS) in almost all over Bangladesh
Analytical Problem Solved	~ 4978

Achievements of IFRD in the fiscal Year 2021-2022

R&D Projects	22
Paper Published	22
Guiding Students	06
Awareness Creation	Organized Seminar and Display of appropriate technology (Biogas and ICS) in 47 Upazillas of Bangladesh

Directors

Sl.No.	Name	From	To
01	Dr. M. Eusuf, Project Director	31/05/77	30/06/80
02	Dr. M. Eusuf, In-charge	01/07/80	02/10/87
03	Dr. M. Eusuf	03/10/87	08/01/90
04	Dr. M. Eusuf, In-charge	09/01/90	30/06/91
05	Dr. Md. Abdus Salek, In-charge	01/07/91	24/11/91
06	Dr. M. Eusuf, In-charge	24/11/91	03/12/91
07	Dr. Shah Abdul Mojid	04/12/91	12/08/92
08	Dr. M. Eusuf, In-charge	13/08/92	09/04/93
09	Dr. Shamim Jahangir Ahmed, In-charge	10/04/93	08/03/95
10	Dr. Abdul Khaleque	09/03/95	10/03/97
11	Dr. Md. Golbar Hossain	11/03/97	26/11/97
12	Dr. M. U. Amin, In-charge	27/11/97	24/05/98
13	Dr. M. Fazlul Huq, In-charge	25/05/98	27/10/98
14	Dr. M. Mosihuzzaman, In-charge	28/10/98	20/07/99
15	Dr. A. J. M. Omar Faruque	21/07/99	20/10/99
16	Dr. Aftab Uddin Ahmed	21/10/99	14/06/01
17	Dr. A. M. Hasan Rashid Khan	15/06/01	11/12/01
18	Md. Sadiqul Islam, In-charge	12/12/01	04/02/03
19	Md. Sadiqul Islam	05/02/03	05/02/03
20	Rokeya Akhter Khanem, In-charge	06/02/03	12/06/06
21	Rokeya Akhter Khanem	13/06/06	28/12/06
22	Md. Samsul Haque, In-charge	28/12/06	25/01/07
23	Kazi Aktaruzzaman, In-charge	25/01/07	26/02/07
24	Dr. Md. Yusuf, In-charge	27/02/07	12/07/07
25	M M Golam Hossain, In-charge	12/07/07	16/07/07
26	Md. Kabir Ahmed, In-charge	16/07/07	11/12/07
27	Jasim Uddin Chowdhury, In-charge	11/12/07	31/10/09
28	Jasim Uddin Chowdhury	01/11/09	29/11/09
29	M M Golam Hossain	30/11/09	30/12/09
30	M. Azizul Islam Kazi	31/12/09	29/03/10
31	Dr. Smarajit Kumar Biswas	29/03/10	01/08/10
32	Dr. Rahima Khatun	01/08/10	18/01/11
33	Mahfuza Khanam, In-Charge	18/01/11	31/01/11
34	Dr. Tofazzal Hossain	31/01/11	29/06/11
35	Sudhangsu Kumar Roy	30/06/11	28/09/11
36	Dr. Md. Abdur Rouf, In-Charge	28/09/11	20/10/11
37	Mahfuza Khanam, In-Charge	20/10/11	15/02/12
38	Mahfuza Khanam	16/02/12	03/07/2018
39	Dr. Eng. Md. Abul Kasem, Addl. Charge	04/07/2018	16/12/2019
40	Dr. Mohammad Shah Jamal, Addl. Charge	17/12/2019	28/02/2021
41	Dr. Shahin Aziz, Addl. Charge	28/02/2021	~

Scientists (Working in IFRD)

Sl.No.	Name	Designation
01	Sujit Kumar Banik	Principal Scientific Officer
02	Dr. Mohammad Shah Jamal	Principal Scientific Officer
03	Mashudur Rahaman	Principal Scientific Officer
04	Dr. Md. Saiful Islam (On Leave)	Principal Scientific Officer
05	Dr. Muhammad Shahriar Bashar	Principal Scientific Officer
06	Dr. Mosharof Hossain	Principal Scientific Officer
07	Dr. Samia Tabassum	Senior Scientific Officer
08	Dr. Toufiq Ahmed	Senior Engineer (SE)
09	Taposhi Rabeya	Senior Scientific Officer
10	Md. Saidul Islam	Senior Scientific Officer
11	Afrina Sharmin	Senior Scientific Officer
12	Mohammad Asadullah Asad (On Deputation)	Senior Scientific Officer
13	Md. Azizul Hoque	Senior Scientific Officer
14	Abu Kowsar	Senior Scientific Officer
15	Md. Sadequl Azam	Scientific Officer
16	Nilufa Yeasmin	Scientific Officer
17	Nasim Ahmed	Scientific Officer
18	Trissa Saha	Scientific Officer
19	Mahedi Hassan	Scientific Officer
20	Jasim Uddin	Scientific Officer
21	Md. Rifat Hossain	Scientific Officer
22	Md. Rashed Alam	Scientific Officer
23	Mst. Mousumi Khatun	Research Physicist
24	Rakib Hossain	Research Chemist (RC)

Officers and Staffs of IFRD

Sl.No.	Name	Designation
1	Kazi Md. Ibrahim Khalil	Administrative Officer(Addl. Charge)
2	Mohd. Shah Alam	Store Officer
3	Most. Nazma Akter	Superintendent
4	Shabnam Mustary	Telephone Operator/PA (Attachment)
5	Md. Babul Shikder	Driver
6	Sumaya Ahmed Asha	UDA
7	Md. Shamim Khan	LDA
8	Chaima Sultana	LDA
9	Mousumi Howlader	LDA
10	Runu Begum	Office Support Staff
11	Rahat Howlader	Office Support Staff
12	Jugesh	Cleaner

Technicians and Staffs of IFRD

Sl.No.	Name	Designation
1	Md. Abdul Hamid	Junior Technician
2	Manisha Ghatak	Junior Technician
3	Md. Shultan Mahmud Shuzan	Junior Technician
4	Md. Farhad Hossain	Junior Technician
5	Md. Abdul Nasir	Senior Lab. Attendant
6	Abdur Rahim Mallik	Senior Lab. Attendant
7	Kumkum Akter	Lab Attendant
8	Kamrunnahar	Lab Attendant
9	Liza Akter	Lab Attendant
10	Md. Abdus Shahid	Lab Attendant
11	Md. Shamim Khan	Lab Attendant
12	Romana Parvin	Lab Attendant

A person wearing a white lab coat and blue gloves is working in a laboratory. They are holding a glass flask containing a blue liquid. The background is a blurred laboratory setting with various equipment and a perforated metal surface in the foreground.

Research & Development Activities (R&D)

R&D Projects List of 2021-22

Sl. No.	Title of the R&D Project
01	Synthesis of Graphene Nanorod as Electron Transport Layer (ETL) for Perovskite Solar Cells (PSCs)
02	Development of an android app to design and calculate the photovoltaic solar home system (SHS)
03	Reduction of CO ₂ gas emissions using solid waste derived catalytic sorbent
04	Development of an artificial intelligence embedded power management device
05	Increasing the photo-conversion efficiency of CdTe-based solar cell by selective Cl-treatment
06	Design development and techno-economic evaluation of a micro-grid photovoltaic system for healthcare in Bangladesh
07	Pre-treatment of agricultural residues (maize stalk) for enhancing biogas and other value-added chemicals production
08	Production of bio energy from waste materials through Microbial Fuel Cell
09	Development of a novel modelling and simulation tool for solar cells
10	Fabrication and characterization of dye sensitized solar cell
11	Fabrication and characterization of thin film solar cell for low-cost solar power
12	Continuous monitoring and collection of solar insulation data at different altitude and latitude among different locations of Bangladesh
13	Development of a photo catalyst for waste water treatment
14	Design and development of devices for solar photovoltaic power system
15	Design and development of indoor solar cooking system
16	Incorporation inorganic hole-transporting material (HTL) for efficient and stable perovskite solar cells
17	Development of magnetic materials for electrical components
18	Production of Bio-Diesel & Fat liquor (for leather processing) from Pithraj, Cotton, Non-edible seeds and Leather fleshing
19	Development of technology for production of lube oil from heavy condensate of different gas field
20	Production of bio lubricating oil from non-edible seeds
21	Methane loss minimization and carbon dioxide recovery systems for water scrubbing based biogas up gradation
22	Study and evaluation of installed biogas plant under different biogas technology dissemination process of BCSIR

Research and Development (R&D) Activities

1. Synthesis of Graphene Nanorod as Electron Transport Layer (ETL) for Perovskite Solar Cells (PSCs)

Dr. Mohammad Shahi Jamal, Professor Dr. Md. Aftab Ali Shaikh, Dr. Shahin Aziz, Mosharof Hossain, Muhammad Shahriar Bashir, Dr. S.M Asaduzzaman Sujan, Dipa Islam

Duration: 2021-2022

Objective:

- ❖ To synthesis graphene oxide from raw graphite flask or powder
- ❖ To grow graphene nanorods on FTO/ITO coated glass substrates by thermal oxidation technique
- ❖ To investigate the structural and surface morphological properties of graphene nanorods as electron transporting material
- ❖ To correlate between the structural and morphological properties of graphene nanorods ETL and the resulting PCE of perovskite device
- ❖ To fabricate and characterize complete perovskite solar cell incorporated with the optimized graphene nanorods

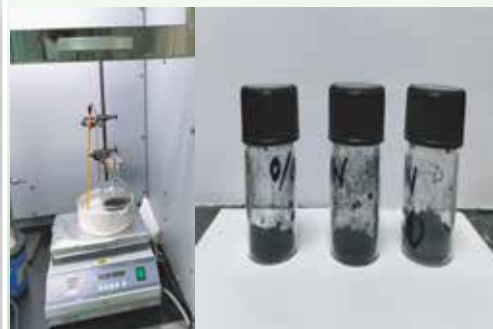


Figure: Synthesis of Graphene oxide from different indigenous

Work Progress:

- ❖ Optimization of process parameter to synthesize graphene oxide from banana stem and mahogany fruit shell have been completed
- ❖ Conversion of graphene oxide to reduce graphene oxide is ongoing

2. Development of an android app to design and calculate the photovoltaic solar home system (SHS)

Muhammad Shahriar Bashir, Afrina Sharmin, Munira Sultana, Ayesha Siddika, Dr. Shahin Aziz

Duration: 2021-2023

Objective:

- ❖ To develop an android based app to design a solar home system
- ❖ To provide direct service to the people of Bangladesh

Work Progress:

- ❖ A vast calculation has been done for the app
- ❖ A prototype has been built
- ❖ Further optimization is ongoing



Figure: Interface of the developed software

3. Reduction of CO₂ gas emissions using solid waste derived catalytic sorbent

Mosharof Hossain, Dr. Mohammad Shah Jamal, Dr. S.M. Asaduzzaman Sujan

Duration: 2021-2023

Objective:

- ❖ To prepare effective sorbent from the indigenous source
- ❖ To design and Development of Reactor
- ❖ To study the performance of the synthesized sorbent in terms of carbon capture

Work Progress:

- ❖ Optimization of process parameter to synthesize catalytic sorbent from waste (Mahogany Fruit Shell and Egg Shell) have been completed
- ❖ Catalyst characterization has been completed
- ❖ CO₂ capture experiments are ongoing



Figure: CO₂ capture experiment in laboratory

4. Development of an artificial intelligence embedded power management device

Md. Saidul Islam, Mahedi Hassan, Md. Sadekul Azam, Sumon Chandra Debnath, Professor Dr. Md. Aftab Ali Shaikh and Dr. Shahin Aziz

Duration: 2021-2023

Objective:

- ❖ To develop a device with advanced technology embedded (AI, IoT) for optimization of grid power usages in office and residential buildings
- ❖ To reduce electric power losses due to inefficient power uses



Work Progress:

- ❖ One product prototype has been designed and developed titled "A smart device for automated data acquisition, storage and wireless monitoring with emergency safety features for laboratory furnaces"
- ❖ One more product prototype development is going on
- ❖ One process has been submitted to BCSIR
- ❖ One patent and one paper are ready for submission

5. Increasing the photo-conversion efficiency of CdTe-based solar cell by selective Cl-treatment

Afrina Sharmin, Muhammad Shahriar Bashir, Munira Sultana, Ayesha Siddiqa, Dr. Shahin Aziz

Duration: 2021-2023

Objective:

- ❖ To fabricate and property analysis of CdTe (p-type) Absorber Layer
- ❖ Cl Treatment of CdTe film to enhance the property of absorber layer
- ❖ To fabricate and property analysis of CdS (n-type) Layer
- ❖ Fabrication of a complete Solar Cell

Work Progress:

- ❖ An extensive literature review has been performed
- ❖ CdS thin film is fabricated by Chemical bath deposition method
- ❖ CdTe thin film has been fabricated by Close Spaced Sublimation (CSS) process
- ❖ CdTe thin film has been treated by CdCl_2 and MgCl_2
- ❖ Characterizations have been performed
- ❖ 2 conference paper has been published
- ❖ 1 journal article has been accepted
- ❖ 1 manuscript is ready for submission

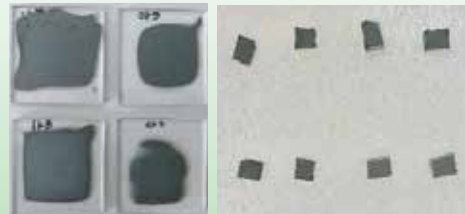


Figure: As deposited CdTe thin film fabricated under different condition and CdCl_2 and MgCl_2 treated CdTe thin films

6. Techno-economic evaluation of a micro-grid photovoltaic system for healthcare center

Abu Kowsar, Md. Saidul Islam, Sumon Chandra Debnath, Mashudur Rahaman, Dr. Nawshad Haque, Dr. Firoz Alam

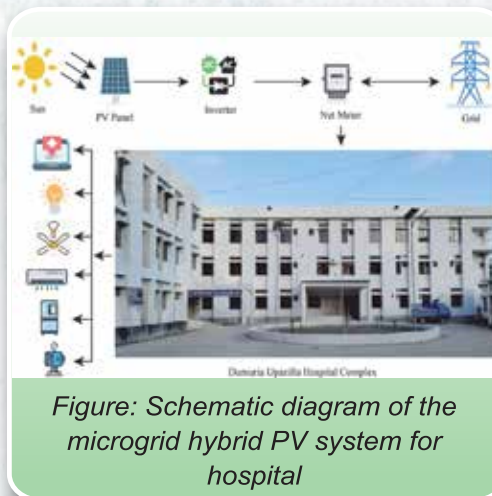
Duration: 2021-22

Objective:

- ❖ To develop an optimized design for a cost-effective, reliable, and sustainable micro-grid PV system for powering healthcare
- ❖ To evaluate the techno-economic feasibilities of this grid-tied system using the HOMER tool
- ❖ To develop an enriched database for country-wide Hospitals with their electric loads, power consumption, solar insulation, and PV electricity generation

Work Progress:

- ❖ An optimized microgrid hybrid solar photovoltaic power system has been designed for the remote healthcare center
- ❖ Techno-economic and environmental feasibilities have been assessed for the grid-tied PV system using the PVsyst, HOMER Computational Tool (HOMER Pro, HOMER Grid, and HOMER Powering Health Tool)
- ❖ A database for country-wide Hospitals with their electric loads, power consumption, solar insulation, and PV electricity generation has been prepared
- ❖ One MS Thesis already supervised
- ❖ Two research articles have been published and another two is under review



7. Pre-treatment of agricultural residues (maize stalk) for enhancing biogas and other value-added chemicals production

Dr. Md. Saiful Islam, Taposhi Rabeya, Mohammad Asadullah Asad, Swapan Kumar Ray, Dr. Mohammad Majedul Haque, and Dr. M Sarwar Jahan

Duration: 2019 - 2022

Objective:

- ❖ Characterize the chemical composition of substrates and identify alterations among species
- ❖ Apply different mechanical, physical and chemical pretreatment methods for enhance the degradation of biomass
- ❖ Evaluate various co-digestion mixtures of substrates and livestock manures in order to boost the methane production of agricultural residues
- ❖ Evaluate mechanical and thermal acidic/alkaline pretreatment methods on partially degraded manure fibers in order to boost the energy output
- ❖ Test micro aeration as a tool to boost lignocellulose deconstruction and subsequently, improve methane production
- ❖ Study other value-added chemicals along with biogas
- ❖ Study the economic feasibility of the technology

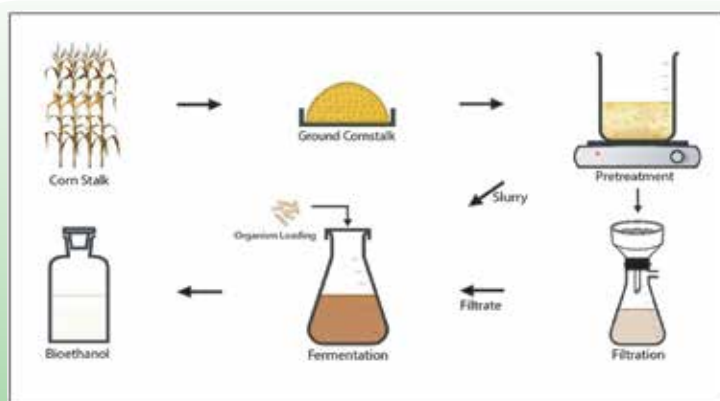


Figure: Process flow of Corn Stalk to Ethanol

Work Progress:

- ❖ Five Scientific papers have been published in international journal
- ❖ Two MS thesis students were supervised under this project

8. Production of bio energy from waste materials through Microbial Fuel Cell

Mosharof Hossain, Dr. Mohammad Shah Jamal, Dr. S.M. Asaduzzaman Sujon, Dr. Saiful Islam

Duration: 2019-2023

Objective:

- ❖ To develop a new bioenergy source
- ❖ To create a safe and sustainable management system for organic matter rich waste in Bangladesh
- ❖ Production of renewable and environmentally friendly Bioenergy, which could be used as electricity

Work Progress:

Eight sets of fuel cell reactors are running successfully for waste water treatment of pulp and paper industry and food industry. Two MS thesis has been completed and two are running.

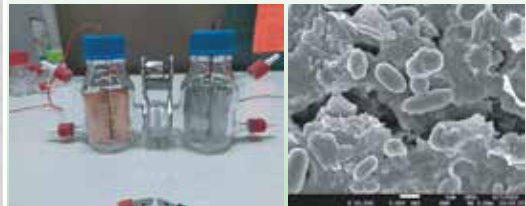


Figure: Microbial fuel cell reactors and Bacteria on carbon plate

9. Development of a novel modeling and simulation tool for solar cells

Abu Kowsar, Md. Saidul Islam, Sumon Chandra Debnath, Sadequl Azam, Mohammad Shahariar Bashar, Mashudur Rahman, Khaleedun Nahar Babi, Dr. Syed Farid Uddin Farhad

Duration: 2019 - 2022

Objective:

- ❖ To develop novel modeling and simulation tools for solar cells
- ❖ To improve the energy conversion efficiency of these devices
- ❖ To commercialize this technology to the industrialists and research organizations for solar cells
- ❖ To provide assistance to the industries, research organizations, and universities for fabricating these devices



Figure: Homepage of MSCS-1D: V2 Simulator

Work Progress:

- ❖ One simulator for multijunction (MSCS-1D: V2) has been developed already, and research work for another two versions is ongoing
- ❖ The photoconversion efficiencies of multijunction and thin-film (CMTS) solar cells have already been enhanced and this work has been published in peer-reviewed journals and proceedings
- ❖ More than thousands of researchers are using our indigenously developed simulator, MSCS-1D
- ❖ Two MS Thesis already supervised and several Thesis students are using our simulator
- ❖ Six research works have been published in different Scopus and Web of Science indexed Journals and IEEE Xplore, and two copyright has been accepted
- ❖ Another 1 Article and 1 Process application is under review
- ❖ Receiving the First Prize for the best poster presentation for the work in the International Conference ICETB-2021

10. Fabrication and characterization of dye sensitized solar cell

Muhammad Shahriar Bashar, Dr. Samia Tabassum, Sumon Chandra Debnath, Munira Sultana, Ayesha Siddika

Duration: 2016-2023

Objective:

- ❖ To manufacture dye sensitized solar cell with traditional roll-printing techniques and local low-cost raw materials
- ❖ To use natural dye which is abundant in nature and compare cell performance
- ❖ To optimize different fabrication conditions and parameters to improve the DSSC performance

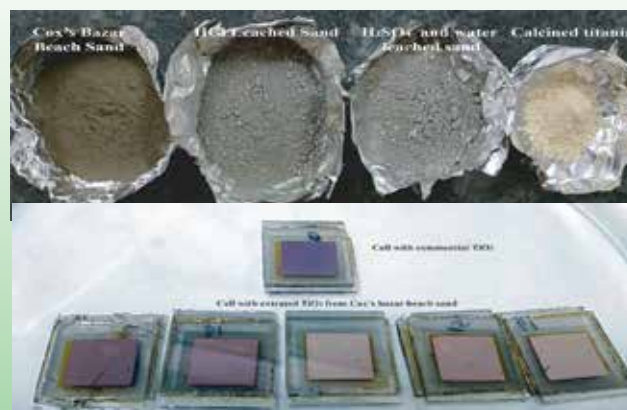


Figure: Dye sensitized solar cell research

Work Progress:

Investigations have been conducted to enhance titanium dioxide from the native beach sand of Cox's Bazar, Bangladesh, to make mesoporous film utilizing the upgraded titanium dioxide to maximize its potential for use in solar cell applications. Selected samples were utilized to manufacture mesoporous films for Dye-sensitized Solar cells using titanium dioxide from sand obtained from the Beach Sand Minerals Exploitation Center in Cox's Bazar and upgraded to titanium dioxide. The upgrading was accomplished by the HCl leaching - H₂SO₄ decomposition - water leaching - repeated dilution, condensation - calcination process, with varying decomposition times. A TiO₂ upgrade of up to 98 percent was attained with this method. The acquired titanium dioxide was used to prepare mesoporous films by screen-printing, which were then utilized as anodes in dye-sensitized solar cells. Using sheets of improved titanium dioxide, the photon conversion efficiency of solar cells manufactured with commercially available titanium dioxide was increased to 52.3 percent.

11. Fabrication and characterization of thin-film solar cell for low-cost solar power

Muhammad Shahriar Bashar, Dr. Samia Tabassum, Mashudur Rahman, Afrina Sharmin, Munira Sultana, Ayesha Siddika, Dr. Abdul Gafur

Duration: 2014-2022

Objective:

- ❖ To develop the concept, materials, and processes necessary to produce environment-friendly thin-film solar cells economically
- ❖ Use of earth-abundant materials
- ❖ Optimization and characterization of different layers of thin-film solar cells

Work Progress:

Fabrication, optimization and characterization of 14 different materials using various methods to enhance the efficiency and performance of different layers of Solar cell has been performed and is ongoing. Furthermore, some laboratory instruments like syringe infusion pump, spray pyrolysis, spin coater, iris pore analyzer, high resistance four-point probe etc. and some accessories have been designed for the fabrication and characterization processes.



Figure: Some developed instrument for thin film fabrication and characterization

Complete CdTe-based and CZTS-based solar cells have been fabricated via different methods. The remarkable photoconversion efficiency of CdTe solar cells has been achieved, and the highest conversion efficiency for CdTe-based solar cells is reached at 5.25%. More than 30 journal articles have been published. 18 MS students were supervised in related research, and 3 Ph.D. students were working on this project.

Thin-film layers	Thickness	Method
Indium tin oxide (ITO)	250~325 nm	Sputtering
Titanium dioxide (TiO ₂)	10~30 μ m	Spin coating, Doctor's blade, Screen print
Zinc sulfide (ZnS)	65~190 nm	Sputtering
Tin sulfide (SnS)	400~600 nm	Sputtering
Cadmium telluride (CdTe)	1~5 μ m	Close Space Sublimation
Cadmium selenide (CdSe)	600~1000 nm	Thermal evaporation
Cadmium sulfide (CdS)	30~60 nm	Chemical Bath Deposition, Sputtering
Zinc oxide (ZnO, ZnO-NR)	1~1.5 μ m	Hydro-thermal, Sol-gel
Molybdenum (Mo)	200~400 nm	Sputtering
Aluminium (Al)	20~90 nm	e-Beam evaporation, Thermal evaporation, Sputtering
Silver (Ag-NP)	5~50 nm	Sputtering
Graphite (C)	5~1000 nm	Screen print, Sputtering
Copper (Cu)	280~380 nm	Thermal evaporation, Sputtering
Copper-Zinc-Tin-Sulphur (CZTS)	1~3.5 μ m	Sputtering

12. Continuous monitoring and collection of solar insulation data at different altitude and latitude among different locations of Bangladesh

Muhammad Shahriar Bashir, Mashudur Rahaman, Dr. Samia Tabassum, Md. Saidul Islam, Afrina Sharmin, Md. Azizul Hoque

Duration: 2014~

Objective:

- ❖ To design solar home system or any kind of solar related analysis, continuous solar radiation data for the year round is needed
- ❖ This project will analyze the solar insolation at different location with different latitude and altitude so that it will design a solar energy map of Bangladesh
- ❖ This map will show the suitable place for implementation of any kind of solar energy system

Work Progress:

For solar energy research time-based solar radiation data like Global radiation, direct radiation, diffused radiation, active sun hour and far-infrared radiation has been being collected from the rooftop of IFRD building. This would be the main database for the solar energy research.



Figure: Solar radiation data collection system

13. Development of a photo catalyst for waste water treatment

Dr. Samia Tabassum, Muhammad Shahriar Bashir, Sumon Chandra Debnath, Ayesha Siddika, Most. Nilufa Yeasmin.

Duration: 2020-2023

Objective:

- ❖ To emphasis the research on water purification by photo catalysis
- ❖ To implement of an innovative technology for water purification using available and nontoxic material
- ❖ To extend photo activity of photo catalyst towards visible region



Figure: Experiment of Waste water treatment

Work Progress:

Photocatalyst material is synthesized in different ways. $\text{TiO}_2\text{-SiO}_2$ composite material, Ag doped TiO_2 and Ag doped composite material have been synthesized. This material was characterized by XRD, SEM, FTIR. Dye degradation was also performed by using this material in under UV radiation and also in direct sun light. One paper regarding to this project has already been submitted. One another paper is ready to submit.

14. Design and development of devices for solar photovoltaic power system

Md. Sadequl Azam, Mashudur Rahaman, Md. Saidul Islam, Abu Kowsar, Sumon Chandra Debnath, Md. Azizul Hoque

Duration: 2020-2023

Objective:

- ❖ To design a smart grid tie inverter (GTI) circuit that will be suitable for our national grid system
- ❖ To develop the grid tied inverter

Work Progress:

An inverter is one of the important major parts of a PV system. Frequency characteristics of grid line has been studied. DC/DC converter, PWM control signal generation for switching high power MOSFET and sine wave inverter has been designed and simulated. One prototype of sine wave inverter has been developed.

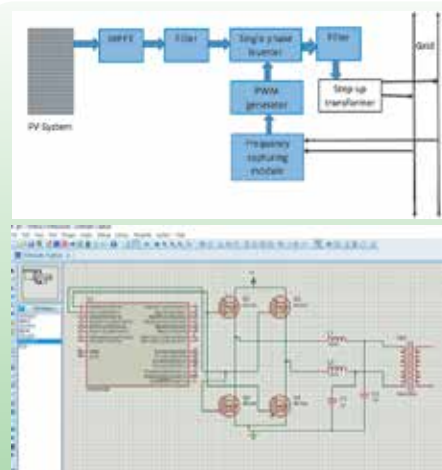


Figure: Block Diagram of Grid tied Inverter System and simulation.

15. Design and development of indoor solar cooking system

Dr. Samia Tabassum, Sumon Chandra Debnath, Ayesha Siddiqa, Most. Nilufa Yeasmin

Duration: 2020-2022

Objective:

- ❖ To design and development of indoor solar cooking system by using solar evacuated tube collector
- ❖ To make a heat control system of cooking chamber
- ❖ To utilize solar thermal energy

Work Progress:

An indoor solar cooking system has been designed and developed. This system includes evacuated tube collectors, heat transfer fluid and cooking chamber. The cooking chamber is highly insulated using different material as it can trap heat for long time and cook food properly. The highest temperature was almost 140°C in under the cooking pot in indoor cooking chamber. This system is capable cook food in clean environment using only solar energy. So, we don't need any fuel cost for cooking.



Figure: Developed indoor solar cooking system on IFRD rooftop

16. Incorporation inorganic hole-transporting material (HTL) for efficient and stable perovskite solar cells

Dr. Mohammad Shah Jamal, Muhammad Shahriar Bashar, Dr. Samia Tabassum, Dr. S.M Assaduzzaman Sujan, Mosharof Hossain

Duration: 2020-2023

Objective:

- ❖ To deposit nickel oxide (NiO) on FTO/ITO coated glass substrates by different deposition techniques
- ❖ To investigate the structural and optoelectrical properties of nickel oxide as a hole transport layer
- ❖ To correlate between the structural and optoelectrical properties of NiO HTL and the resulting power conversion efficiency of perovskite device
- ❖ To fabricate and characterize complete perovskite solar cell incorporated with the optimized NiO



Figure: Fabrication of Perovskite Solar Cell

Work Progress:

- ❖ Optimization and characterization of NiO thin film deposition through spin coating has been completed
- ❖ Optimization substrate temperature for deposition of NiO thin film deposition through sputtering has been completed
- ❖ Optimization of Perovskite solar cell fabrication using optimized HTL is ongoing

17. Development of magnetic materials for electrical components

Mashudur Rahaman, Md. Azizul Hoque, Syed Shafquat Mahmood, Md. Sadequl Azam, Md. Saidul Islam

Duration: 2020-2023

Objective:

- ❖ To synthesis magnetic material having specific property for industrial applications
- ❖ To prepare a magnetic material of required shape and size
- ❖ To harness cost effective preparation techniques for magnetic materials
- ❖ To establish a smooth research capacity for energy material research

Work Progress:

- ❖ LiNiCuMg ferrites with Ti Doping have been prepared by using conventional ceramic method
- ❖ LiNiCuZn ferrites with Polycrystalline Ti doping have been prepared by using conventional ceramic method
- ❖ XRD pattern, microstructure, magnetic and electrical properties of the prepared materials have been studied



Figure: Magnetic materials have been prepared in laboratory.

18. Production of Bio-Diesel & Fat liquor (for leather processing) from Pithraj, Cotton, Non-edible seeds and Leather fleshing

Sujit Kumar Banik, Dr. Modhu Sudan Saha, Dr. Md. Saiful Islam, Taposhi Rabeya, Mohammad Asadullah Asad, Trissa Shahia

Duration: 2020-2022

Objective:

- ❖ To study the characteristics of seeds oil and leather fleshing
- ❖ More efficient use of leather fleshing waste and significantly reduce environmental pollution
- ❖ To develop a process for bio-diesel & fat-liquor production from seeds oil and leather fleshing



Figure: Bio-diesel

Work Progress:

Two scientific papers & one conference paper were published. Three thesis students from Dhaka University have been supervised under this project.

19. Development of technology for production of lube oil from heavy condensate of different gas field

Sujit Kumar Banik, Dr. Md. Saiful Islam, Taposhi Rabeya

Duration: 2020-2022

Objective:

- ❖ To study the characteristics of condensate
- ❖ To develop a process for lube oil production from gas field's condensate
- ❖ To save foreign currency

Work Progress:

- ❖ Heavy condensate has been collected
- ❖ Characterization of raw material have been done



Figure: Collected heavy condensate

20. Production of bio lubricating oil from non-edible seeds

Sujit Kumar Banik, Taposhi Rabeya, Trissa Shaha

Duration: 2016-2022

Objective:

- ❖ To develop a process for bio-Lubricant production from non-edible seed oil
- ❖ To study the characteristics of produced bio-lubricating oil
- ❖ Creation of employment opportunity
Reduction of import cost of lubricating oil, poverty alleviation etc.
- ❖ Reduce Greenhouse gas emission



Figure: Rubber and Castor seeds

Work Progress:

one scientific paper and one conference paper was published. One thesis student was supervised under this project.

21. Methane loss minimization and carbon-dioxide recovery systems for water scrubbing based biogas up gradation

Mosharof Hossain, Dr. Mohammad Shahi Jamal, Dr. S. M. Asaduzzaman Sujan

Duration: 2020-2023

Objective:

- ❖ Optimize the water scrubbing technology to produce high quality biomethane
- ❖ Minimization and Recovery CH_4 loss and CO_2 from the off gas stream of the plant
- ❖ To reduce greenhouse gas emissions into the environment
- ❖ To increase the economic viability of the biogas upgrading setup
- ❖ To make the complete process carbon negative



Figure: Water scrubbing flow diagram

Work Progress:

Design of the Water Scrubbing Column have been completed. Total system is ready to install.

22. Study and evaluation of installed biogas plant under different biogas technology dissemination process of BCSIR

Dr. S.M. Asaduzzaman Sujon, Dr. Mohammad Shah Jamal, Mosharof Hossain

Duration: 2020-2023

Objective:

IFRD, BCSIR installed around thirty thousand Biogas plant all over the country under different biogas dissemination projects of BCSIR. More than one lac and fifty thousand people are directly getting benefits from these plants. Objectives of this project are:



Figure: Biogas plant installed by IFRD

- ❖ To evaluate the present condition of the installed biogas plants
- ❖ To identify the technical problem of the developed biogas technology
- ❖ To evaluate the benefit of the biogas plant users
- ❖ To evaluate the social, economic and climatic impact in the society
- ❖ To provide the data and information to the GO and NGO bodies (National Parliament, different Ministry etc.) about biogas technology and its performance

Work Progress:

Eight districts have been visited in this year. Around 195 Biogas plant have been evaluated. It was found that around 93.5% biogas plant are in running condition.

Analytical Services

One of the routine activities of this institute is to help entrepreneurs, industrialists and individuals to solve their industrial problems. Problems referred to this institute include analyses of various raw materials. Furthermore, custom authorities of our country regularly send samples of different items to confirm the quality specifications agreed upon between the Government of Bangladesh and the importing countries. In this way, the institute helps industries to formulate and produce quality products and also overcome difficulties related to various technical/scientific problems. About 186 industrial analytical services referred by government and non-government agencies of the country were solved by the well-trained scientists and technicians of the institute during this period.



Figure: Scientists are working in laboratory

Technology Transfer Services and Creation of Public Awareness

Technical support has been given to a number of organizations and users of the improved stove and Biogas plant. 47 seminars on Improved cook stove, Biogas, Solar energy and Power saving technology were conducted at 47 Upazilas of the country under the seminar "Application and Dissemination of Appropriate Technologies" arranged by the Ministry of Science and Technology and local Upazila administration. IFRD also provides awareness creating services for saving of energy and better environment through leaflets, posters, website, etc.



Figure: Seminar and Exhibition on Appropriate Technologies

Seminar And Workshop Organized for Stakeholders

On 27 February, 2022, Institute of Fuel Research and Development organized a seminar and workshop on “চতুর্থ শিল্পবিপ্লবের প্রতিশ্রুতি, সবুজ জ্বালানির উন্নতি” with the stakeholders. About 120 representatives of government and non-government organizations and different universities of the country participated in this seminar and workshop. In the seminar, discussions were held on various research results, the range of services of IFRD and suggestions & needs of the participants.



Figure: Seminar and workshop with stakeholders

Visiting Industry and Solving the Identified Problems

In the year of 2021-2022, scientists of Institute of Fuel Research and Development (IFRD) visited 05 industries in different districts of the country and suggested solutions to some of the identified problems.



Figure: Some photographs of industry visit

Published Scientific Articles

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- [12] AK Mondal, S Wu, D Xu, Q Zou, L Chen, L Huang, F Huang, Y Ni. "Preparation of lignosulfonate ionic hydrogels for supercapacitors, sensors and dye adsorbent applications." *Int J Biol Macromol* 2021;187:189-99. <https://doi.org/10.1016/j.ijbiomac.2021.07.021>.
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Accepted Process

Title of the process:

"Production of Gravity Power Lamp"

BCSIR Ref. No.:

39.02.0000.043.37.821.20/1241 **Date:** 19.01.2022

Related Scientists:

Muhammad Shahriar Bashar, Munira Sultana,
Ayesha Siddika and Syed Shafquat Mahmood



Figure: Gravity Power Lamp

Submitted Patent

Title: Development of Photo-Catalyst Based Waste Water Treatment System

BCSIR Ref. No.: 39.02.0000.043.37.829.20/644 **Date:** 05.10.2021

Scientists pursuing M.S/M.Phil/ Ph.D. courses in home or abroad

- ⇒ Taposhi Rabeya, Senior Scientific Officer, IFRD, BCSIR has been pursuing Ph.D. in the Department of Applied Chemistry and Chemical Engineering University of Dhaka, Bangladesh under the supervision of Dr. Mohammad Ismail, Associate Professor of same department. She is working on a thesis entitled "Production of bioethanol and other value added biochemicals from agro residues: An eco - friendly approach".
- ⇒ Mohammad Asadullah Asad, Senior Scientific Officer, IFRD, has been pursuing Ph.D. program in the Department of Chemistry and Biochemistry, School of Chemical and Biomolecular Sciences, Southern Illinois University, Carbondale IL, USA, in the field of Bioanalytical Chemistry under the supervision of Dr. Mohtashim H. Shamsi in MEB lab.
- ⇒ Afrina Sharmin, Senior Scientific Officer, IFRD, has been pursuing Ph.D. degree in the Department of Electrical and Electronics Engineering, University of Dhaka, Bangladesh under supervision of Professor Dr. Zahid Hasan Mahmood, and working on a thesis entitled "Optical and Morphological Characterization of Copper Zinc Tin Sulfide Nano-crystal thin film Solar Cell".
- ⇒ Munira Sultana, Scientific Officer, IFRD, has been pursuing M.Phil. degree in the Department of Physics, Bangladesh University of Engineering and Technology, under supervision of Associate Professor Dr. Muhammad Rakibul Islam.
- ⇒ Mashudur Rahaman, Principal Senior Scientific Officer has been pursuing Ph.D. degree from the Department of Physics, Jahangirnagar University, Bangladesh under the supervision of Prof. Dr. Farid Ahmed and working on a thesis entitled "Fabrication and characterization of nano-structured thin film Photovoltaic Cells."

Participation in Scientific Training

Sl. No.	Participants	Title of Training	Duration	Training Institute
1.	Dr. Samia Tabassum, SSO	Inhouse training on X-Ray Photoelectron Spectrometer (XPS)	05-09 September 2021	IGCRT, BCSIR
2.	Most. Nilufa Yeasmin, SO	Inhouse training on BET Sorptometer	07-11 November 2021	CARF, BCSIR
3.	Afrina Sharmin, SSO Md. Sadequl Azam, SO	Inhouse training on X-Ray Diffractometer (XRD)	02-06 January 2022	IGCRT, BCSIR
4.	Md. Sadequl Azam, SO Ayesha Siddika, SO Most. Nilufa Yeasmin, SO Trissa Shah, SO	Inhouse training on Laboratory Safety and Improved Cook Stove	06-09 February 2022	IFRD, BCSIR
5.	Afrina Sharmin, SSO	Inhouse training on WD-XRF	06-10 March 2022	IMMM, BCSIR

Academic Research Guidance/Supervision

Sl. No	Name of the Student	Title of the Research	Research Category	Name of Academic Institution	Name of Supervisor in BCSIR
1	Robiul Islam	Integration of inorganic hole transport material (NiO) for perovskite solar cell	MS	Noakhali Science and Technology University	Dr. Mohammad Shah Jamal
2	Mahmudul Islam Rayen	Removal of CO ₂ from biogas using K ⁺ impregnated CaO solid catalyst	MS	Jahangirnagar University	Mosharof Hossain
3	Humayun Iqbal	Secondary energy production from pulp and paper industry wastewater using microbial fuel cell	MS	Jahangirnagar University	Mosharof Hossain
4	Arup Voumik	Industrial waste water treatment by double chamber microbial electrochemical cell	MS	Jahangirnagar University	Mosharof Hossain
5	Md. Mohaimenul Islam	Design and techno-economical evaluation of micro-grid photovoltaic system of hospital in Rangpur	MS	Begum Rokeya University, Rangpur	Abu Kowser
6	Ahmad Icha	Modeling, simulation and performance optimization of novel Cu ₂ MnSn ₄ (CMTS) solar cell	MS	Begum Rokeya University, Rangpur	Abu Kowser

Different Committee list of IFRD

1. Official Estimated Price and Specification Preparation Committee

Dr. Mohammad Shah Jamal, PSO, IFRD, BCSIR	Convener
Dr. Md. Humayun Kabir, SSO, INARS, BCSIR	Member
Md. Sadequl Azam, SO, IFRD, BCSIR	Member-Secretary

2. Tender and Proposal Opening Committee

Sujit Kumar Banik, PSO, IFRD, BCSIR	Convener
Md. Minhaz Sahed Khan Rizvee, DDA, BCSIR Secretariat	Member
Assistant Secretary/Administrative Officer, IFRD, BCSIR	Member-Secretary

3. Tender and Proposal Evaluation Committee

Muhammad Shahriar Bashir, PSO, IFRD, BCSIR	Convener
Mosharof Hossain, PSO, IFRD, BCSIR	Member
Afrina Sharmin, SSO, IFRD	Member
Sujit Kumar Banik, PSO, IFRD, BCSIR	Member
Dr. M.L. Palash, Associate Professor, Dept. of EEE, DU	Member
Dr. Kazi Haniun Maria, Professor, Dept. of Physics, DU	Member
Assistant Secretary/Administrative Officer, IFRD, BCSIR	Member-Secretary

4. Tender and Proposal Opening Committee for EGP

Mashudur Rahaman, PSO, IFRD, BCSIR	Convener
Md. Saidul Islam, SSO, IFRD, BCSIR	Member-Secretary

5. Tender and Proposal Evaluation Committee for EGP

Director, IFRD, BCSIR	Convener
Dr. Sumon Ahmed, Associate Professor, IIT, DU	Member
Md. Saidul Islam, SSO, IFRD, BCSIR	Member-Secretary

6. Low-Cost Tender and Proposal Evaluation Committee

Mosharof Hossain, PSO, IFRD, BCSIR	Convener
Dr. Humayun Kabir, SSO, INARS, BCSIR	Member
Md. Saidul Islam, SSO, IFRD, BCSIR	Member-Secretary

7. Acceptance/Verification Committee

Md. Saidul Islam, SSO, IFRD, BCSIR	Convener
Md. Sadequl Azam, SO, IFRD, BCSIR	Member
Ayesha Siddika, SO, IFRD, BCSIR	Member
Assistant Secretary/Administrative Officer, IFRD, BCSIR	Member
Md. Azizul Hoque, SSO, IFRD, BCSIR	Member-Secretary

8. Publication Committee

Dr. Mohammad Shah Jamal, PSO, IFRD, BCSIR	Convener
Afrina Sharmin, SSO, IFRD, BCSIR	Member
Md. Azizul Hoque, SSO, IFRD, BCSIR	Member
Ayesha Siddika, SO, IFRD, BCSIR	Member
Md. Saidul Islam, SSO, IFRD, BCSIR	Member-Secretary

Photo Gallery



Workshop with Stakeholders of IFRD-2022

Venue: IFRD Auditorium, BCSIR



Training program on Improved Cook Stove and Laboratory Safety-2022 in IFRD



Inauguration of Biogas Research Laboratory (Refurbished) in IFRD



Training program on 'Patent Drafting' arranged by IFRD, BCSIR



National Integrity Prize (2021-22) giving program in IFRD



Performance Assessment program of Improved Cook Stove in IFRD



Laboratory Visit program for students in IFRD



Photographs of some other official programs





Instrument Facilities of IFRD

Instrument Facilities of IFRD

Glove Box



- Used for device fabrication
in inert environment

FTIR Oil Analyzer



- Used to analyze lubricating oil

Automotive Emission Analyzer



- Used to analyze emission gas

Spectrum Analyzer for Electric Lights



-Used to analyze spectrum of lights

Instrument Facilities of IFRD

Atomic Force Microscope



- Used for topographic imaging and force measurement

Closed Space Sublimation



- Used for thin film fabrication by physical vapor deposition method

Co-Sputtering System



- Used for thin film deposition by sputtering method with scope to use multiple target simultaneously

Electron-Beam & Thermal Evaporation System



- Used for depositing thin film by two techniques-Thermal deposition & E-beam thermal deposition

Hall Effect Measurement Unit



- Used for measuring Hall voltage, Bulk resistance, Sheet resistance, Carrier Concentration etc.

RF Magnetron Sputtering



- Used for thin film deposition with very low defects in a cold plasma environment.

Instrument Facilities of IFRD

Sun Simulator for Solar Cell



- Used for measuring the performance of a solar cell by creating illumination close to that of sunlight.

Surface Profilometer



- Used for surface profiling a thin film and measuring its thickness thereby

Thermal Evaporator



- Used for depositing thin film by Thermal evaporation, a type of Physical Vapor Deposition (PVD)

Trinocular Stereo Microscope



- Used for having an enhanced microscopic view and imaging of thin films

UV-Vis-NIR Spectrophotometer



- Used to determine the optical properties (transmittance, reflectance and absorbance) of liquids and solids.

VPSEM-EDX



- VPSEM is Used for the surface characterization by high resolution imaging and analyzing of a wide range of materials.
- EDS is used for quantitative analysis of materials.

Instrument Facilities of IFRD

XRD



- Used for phase identification of a crystalline material and can provide information on unit cell dimensions

Rapid Thermal Annealer



- Used to rapidly heat a sample to temperatures of up to 1200 °C

Elemental Analyzer



- Used for CHNS-O analysis

HPLC



- Used for sugar, bioethanol analysis

GC



- Used for biogas and biodiesel analysis

Planetary Ball Mill



- Used for grinding sample materials down to very small size

Instrument Facilities of IFRD

Impedance Analyzer



- Used to measure complex electrical impedance as a function of frequency and temperature

Spin Coater



- Used to deposit uniform thin films

Dip Coater



- Used to deposit uniform thin films to flat substrates

Rotary Evaporator



- Used for the efficient and gentle removal of solvents from samples by evaporation

Digital Centrifuge Machine



- Chemical Separator/ Sedimentation device
- Used to separate various components of a fluid

Bomb Calorimeter



- Applicable to determine heat of combustion, gross calorific value of solid, liquid fuels

Instrument Facilities of IFRD

Closed Cup Flash Point Analyzer



- Suitable for analysis of mineral and synthetic lubricants including turbine, distilled fuel, heavy fuel oil (HFO), crude, glycol coolants

Flash point Tester



- Suitable for analysis of mineral and synthetic lubricants including turbine, distilled fuel, heavy fuel oil (HFO), crude, glycol coolants
- Applicable for flash point in negative temperature too

Flame Photometer



- Can be determine Sodium, Potassium, Barium and Lithium

Open Cup Flash and Fire Point Analyzer



- Suitable for analysis of mineral and synthetic lubricants including turbine, distilled fuel, heavy fuel oil (HFO), crude, glycol coolants

Portable Biogas Analyzer



- Applicable to determine biogas component onsite

Dip Coater



- Used to deposit uniform thin films to flat substrates

Scientists of IFRD





INSTITUTE OF FUEL RESEARCH AND DEVELOPMENT (IFRD)
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH (BCSIR)



Dr. Qudrat-i-Khuda Road,
Dhanmondi, Dhaka-1205



02-58615614



E-mail: dir-ifrd@bcsir.gov.bd



<http://ifrd.bcsir.gov.bd/>